

# EXHIBIT E

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## GAU-4 20mm Vulcan

## M61A1/M61A2 20mm Automatic Gun

The M61A1 utilized by the F-14 and F/A-18 aircraft is a hydraulically driven, 6 barreled, rotary action, air cooled, electrically fired weapon, with selectable rates of fire of either 4000 or 6000 rounds per minute. The M61A2 20mm light weight gun is utilized in the F/A-18 aircraft only. The gun system is mated to a linkless ammunition storage and handling system. The F-14 has a capacity of 676 rounds while the F/A-18 has a capacity of 578 rounds of 20mm linkless M-50 or PGU series electrically primed ammunition. World War II fighters and bombers were commonly equipped with Browning M2 heavy barrel .50 cal. machine guns which had a maximum firing rate of 1,200 spm. The Gatling gun had exceeded that rate of fire in 1880. In 1946, U.S. Army Ordnance Research and Development Service engineers dusted-off the old Gatling principle and adapted it to create the 6,000 spm M61 series Vulcan 20mm Gatling gun. The Gatling principle permitted a high rate of fire while reducing heat and barrel erosion.

In June 1946, the General Electric Company was awarded the contract for "Project Vulcan". In 1950, GE delivered ten initial model A .60 cal. T45 guns for evaluation. Thirty-three model C T45 guns were delivered in 1952 in three calibers: .60 cal., 20mm, and 27mm, for additional testing. After extensive testing, the T171 20mm gun was selected for further development. In 1956 the T171 20mm gun was standardized by the U.S. Army and U.S. Air Force as the M61 20mm Vulcan aircraft gun.

The M61 20mm Vulcan is an externally powered, six-barrel, rotary-fire gun having a rate of fire of up to 7200 spm. The firing rate is selectable at 4,000 spm or 6,000 spm. The gun fires standard electrically primed 20mm ammunition. The M61A1 is hydraulically or ram-air driven, electrically controlled, and uses a linkless ammunition feed system.

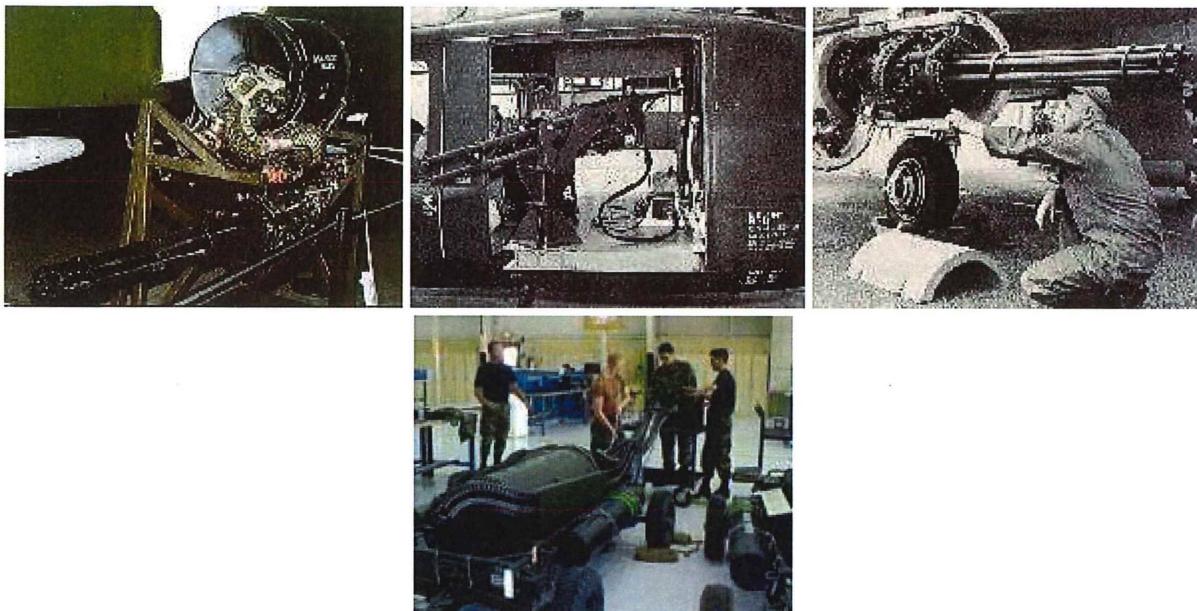
Each of the gun's six barrels fires only once during each revolution of the barrel cluster. The six rotating barrels contribute to long weapon life by minimizing barrel erosion and heat generation. The gun's rate of fire, essentially 100 rounds per second, gives the pilot a shot density that will enable a "kill" when fired in one-second bursts.

The M61 20mm cannon is a proven gun, having been the US military's close-in weapon of choice dating back to the 1950s. The F-104, F-105, later models of the F-106, F-111, F-4, B-58, all used the M61, as does the Air Force's F-15, F-16 and F-22, and the Navy's F-14 and F/A-18. The internally mounted 20mm cannon system is common to all versions of the F-15. This system combines the widely used (F-4, F-16, F-18) M61 cannon with 940 rounds (A through D models) or 500 rounds (E model) of ammunition. The cannon can be loaded with target practice, armor piercing, or high explosive incendiary rounds. The primary use of the cannon is in the extremely short range (less than 2000 feet) air-to-air environment, where more sophisticated air-to-air missiles are ineffective. Alternately, the cannon has limited usefulness in a ground strafing role.

The M61A2 is a lightweight version of the M61A1. Most of the weight savings was achieved by machining down the barrel thickness.

# Specifications

<b>Designation</b>	M61A1, M61A2
<b>Type</b>	Six-barrel, hydraulically operated 20mm Gatling gun
<b>Contractor</b>	General Dynamics Armament Systems
<b>Rate of Fire</b>	6,000 rounds per minute
<b>Effective Range</b>	Several thousand yards



## Sources and Resources

- [THE GATLING GUN](#)

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<http://www.fas.org/man/dod-101/sys/ac/equip/m61.htm>

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Originally created by John Pike

Updated Sunday, April 23, 2000 7:24:33 AM